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Science and Technology: A Catalyst for Improving Human Health in Developing Countries

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Opinion Article

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ABSTRACT

Science and technology have the potential to make major contributions to the development of medical devices that can help address the highest burdens of diseases in developing countries. This paper examined how science and technology could assist in speeding the development and dissemination of information on new health products that could address the largest health threats in developing countries. The paper investigated the traits needed by such production to have the desired impact. It also reviewed the extent to which some medical devices and processes possess those traits and discuss the potential of science and technology to develop health products, reveal the constrains on product development and the mechanism in overcoming the new health products. Towards understanding the potential of science and technology to develop more new health products to addressing high-burden diseases, it was therefore recommended that there is need to consider the characteristics of diagnostics, drugs, vaccines and medical devices that could most effectively and efficiently address the critical continent health problems. Science and

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technology should focus on bio-technologies that could help improve health products that are affordable and appropriate to the circumstances of developing countries, using instrument to addressing the most pressing health needs and be appropriate to the health conditions that cause the largest burden of diseases in developing countries of the world.

Keywords: Science; bio-technology; human health; developing countries; genomes.

1. INTRODUCTION

Science and technological progress have contributed substantially as the key driver to modern development and improvement in human health system. In facts, some scientific and technological discoveries have been of exceptional importance to public health o vaccinations for small pox, by the discovery of the oral polio vaccine, more effective family planning devices, treatment of malaria fever and other health threats among children including HIV and AIDS [1,2]. The enhancement of medical devices such as bifornicated needles, syringes, the inoculated lens, medical knives and the use of X-ray instruments have also had an impact on public health development through science and technology. There are very substantial gains in health that could be obtained from the effective implementation of existing science technologies using well-known highly effective low cost interventions but not widely used in developing countries in reducing maternal death and disability [3]. Others include appropriate speedy transportation to hospital on emergency, Obstetric health care, reducing young child death by expanding health coverage with the six basic antigens, morbidity and mortality on tuberculosis by expanding case finding cure rates using DOTS approach system, promoting exclusive breast feeding for months, reducing neonatal deaths by training birth attendants in resuscitation, provision of antibodies, keeping the baby warm, focusing on the scientific and technological matters that concern global health [4].

Experience has shown that there are scientific areas that can help improve health in developing countries which include the engineering of mosquitoes that are incapable of carrying malaria parasite and other transmittable diseases, discovers new drugs and develop less effective vaccines [5]. The health conditions resulting in the largest health threats in developing countries which require diagnostics, vaccines, drugs and medical devices appropriate to the needs of the populace have not been addressed properly.

2. DEFINING SCIENCE AND TECHNOLOGY

Science and technology involve the use of scientific investigation products and tools Processes. It involves the application of engineering to solve practical problem of human daily life [6]. It also concerns with the use of scientific and applied techniques, skills, health methods and materials used in the production of goods and services. This involves the accomplishment of objectives such as scientific investigation and application of engineering to solve the practical problem of daily life of man.

Technology is basically human health knowledge that is used to create products and artifacts with the help of innovative tools for manufacturing health materials and used in communication and learning, securing data and transportation for human activities [7]. Thus, healthy food products, good habitation technologies, public health sanitations and production of essential health needs (drugs) for the needy communities are necessary among the health priorities.

The public institutions involved in science and technology need to be aware of their responsibilities, regulate, legislate, respect human life and society and charged for failure or omission, since we live in age in which the power of science becomes evidence every day.

Globally, a better quality of life, the advancement in medicine and public health has doubtlessly contributed to an increase in the life expectancy [8]. Today, expectancy of life is about 64 years and will probably be more than 70 years in 2020 unless pandemic diseases such as AIDS, child killer diseases, cancer, and endocrine dysfunctions reverse this picture [6, 9,10].

Although science and technology help to relieve the situation, diseases known for long time are still killing the poors and deprived. Thus, there is need to address the health threats such as cerebrovascular and heart diseases, violence, diabetes, stroke, malaria, dengue fever, leishmaniasis, filariasis, cholera, viral diarrhea, AIDS and Chagas disease such as cerebrovascular and heart diseases, violence, diabetes, stroke, malaria, dengue fever, leishmaniasis, filariasis, cholera, viral diarrhea, AIDS among the populace suffering typically in the developing countries [11].

Specifically, it has been observed that disease for the developing countries really affected poor people living in nearly inhabitable environments. Thus, the health sectors whose strategies during the last 20 years were based on equality and the promise health for all witness an increase of disparities to be seen with the naked eye [3]. Thus, through collaborative efforts in research, science and technology in the universities, research centres and private enterprises, there is need to invest in new drug vaccine and therapies for the control and eradication of endemic diseases typically among the poor countries.

3. POTENTIALS OF SCIENCE AND TECHNOLOGY

Towards improving human health, scientific progress has led to identifying four areas in which science could be harnessed to address some of the gaps noted. Sequencing the genomes of important pathogens will help scientist understand better why those pathogens cause diseases, how they develop resistance and what drugs can best fight them while reducing the onset of resistance [12]. For example, the sequencing of mosquito genome may allow scientist to engineer mosquitoes so that they cannot carry malaria and spread dangerous virus causing Other diseases such as lymphatic filariasis. The development of new and better drugs such as hepatitis vaccine will facilitate the improvement in information technology in chemistry and robotics genetics and molecular epidemiology (World Health Organization [3]. In addition, a number of DNA technology exist that can assist in the desiring and manufacturing new and improved hepatitis vaccine [12]. Genetic modifications of plants is possible by enriched genetically modified crops to biofortify plants such as producing banana for vitamins A, E, iron and zinc, to improve protein quality of rice known as Golden Rice, rice-wheat rotation to significantly enhance food production by biotechnology, and drugs for latent tuberculosis and vaccines for human papilloma virus [13].

However, the international health programmes focus on science and technology to Provide opportunities for health representatives and join with political intellectuals, activists and economic leaders of the world, in continuing constructive dialogue to design concrete health projects to enhance the quality of life of the populace. Science and technology becomes important for all countries in addressing traditional developmental issues and in coping with increased international flow of goods and services, control and prevention of rapid spread of contaminants and diseases. For example, United State International Development, [4] has significant programme for many developing countries in the areas of health, agricultural research, food environmental security, eradication of poverty in resource-deficient countries, child survival, safe water, micro-economic reform, prevention of and response to natural disasters [4].

The combination of computers, the internet and mobile devices has the capacity to Transform human health needs. According to the United Nations International Telecommunications Union (UN-ITU), by the end of 2016, there were an estimated 5.3 billion mobile cellular subscriptions worldwide, including 940 million subscriptions to 3G services.

About 90 percent of the worlds population can access mobile networks, with three-quarters of mobile subscribers living in developing economies. In some parts of the world, telemedicine has been used to overcome life threatening health challenges to some extent. Telemedicine is the practice of medical and public healthcare supported by a mobile device, including the use of voice, data and SMS [14]. By adopting mobile health (mHealth) in the healthcare delivery system, many more people will potentially be reached and the health of people and communities in most developing countries will be greatly enhanced.

The mHealth approach is particularly important due to the rapid adoption of mobile phone technology in developing countries. While mHealth has matured in industrialized nations, the field is still evolving in most developing countries. As mobile technology grows, more and

more people acquire mobile phones and other mobile devices, making the devices part of their everyday lives. It then becomes easier for medical personnel to interact with them and provide health services, obtain health information to aid their researches and make it easy for them to provide the right medical solutions to health challenges in remote locations. It affords the medical personnel the ease of monitoring their patients regardless of their location. With the aid of Smartphone-based applications, it is now possible to conduct simple but life-saving diagnostic and treatment manuals, tools to calculate pulse and respiratory rate as well as proper drug dosages at a very minimal cost. However, the continued and equitable expansion of information communication technology (ICT) depends on electricity. The real divide over the next 10 years will be between those who have access to reliable electricity to power these devices and those who do not.

It is with the intention of reducing various diseases associated with unhygienic environment in developing world that prompted Bill Gates & Melinda Foundation to commission Indias Biotechnology Industry Research Assiatance Council (BIRAC) to pick some teams of researchers to receive grants worth $2 million in total, and helps solve the global sanitation crisis through innovative toilet solutions [15]. Some of the developed toilets are high-tech toilets that uses microwave to convert human waste into electricity, solar-powered toilet that separates liquids from solids and converts them into commercially viable end products among other inventions.

The World Banks estimated the annual global cost of poor sanitation to be about $260 billion.

Equally, some 2.5 billion people in the world who have no access to modern sanitation and toilets [3]. The cost of poor sanitation is not just money, but precious lives too if considerations are given to the fact that over 1.5 million kids that died every year are due to diarrhea a disease originating from un-sanitized toilets and disease such as polio that is still ravaging developing countries like wild fire.

Furthermore, towards improving global health, science and technology have viewed the bio-technologies that can help improve health in developing countries. In addition, scientists focus on the extent to which technologies would be affordable and appropriate to the circumstances of developing countries, using instrument addressing the most pressing health needs in the next 5 to 10 years [1]. Furthermore, it focuses on the advanced knowledge with important benefits in both rural and urban areas in developing nations and the development of new diagnostics, childhood vaccines and drugs, improve water and sanitation, empower women to protect themselves against sexually transmitted infections (STIs), HIV and microbicides [16]. Other significant areas of global health concerns in scientific advancement supported by science and technology include improvement of nutrition, curing latent chronic infections and introduction of oral rehydration therapy (ORT) which become the cornerstone of international effort to control diarrheal diseases [17].

The use of bio-remediation to clean contaminated soil or water to promote food production to prevent the spread of infectious water-borne diseases could be related to products of science and technological development.

4. CONSTRAINTS TO APPLYING SCIENCE AND TECHNOLOGY TO GLOBAL HEALTH THREATS

Globally, it appears that the strength of existing products on scientific knowledge could make an important differences on the poor health of the people have not been developed such as the development of drugs for HIV and malaria vaccine. These are several common constraints to the development of desired health products including the new diagnostic, vaccines, drugs, and delivery health services concerned for profit sector. However, a number of factors have hampered the rapid growth of health care system ranging from moderate health facilities, shortage of health personnel, health information system, high illiterate rate among people, and power supply to bandwidth.

Many people in developing countries lack access to health technologies even basic ones such as life-saving medicine and medication for asthma attack to improve breathing system. Limited access to other health products such as vaccine, diagnostics for infectious and chronic diseases and preventive technologies such as insecticide-treated bed nets and various kinds of contraceptives are among the constraints. The developing countries are waiting exclusively

for technology transfer from the developed countries in the areas of genome of plants, microorganism and animal use of fungi, with therapeutic actions, recombinant DNA technology, and improvement of conservation techniques for biological materials and cloning of plants and animals [13]. This signifies to deepen the existing crisis, even in the era of globalization. It is very difficult for the developing countries to gain access to new health technologies. Multi-national co-operations with expertise in genetic engineering technology techniques are involved in vaccines production with extensive protected industrial property rights. They thus doubt the ability of low-income individuals to afford cost for their health products that would give them a sufficient return on their capital. In addition, they doubt that government in developing countries could afford their products on Hepatitis B and Hemophilus influenza type b (Hib) [9].

Moreover, the high cost of developing a new product can be very high to bring a new drug from research to market. Given those cost, profit making firms will invariably want to use their capital to develop a potential rather than develop a drug for low-income countries on which the firm believes it will not be able to account its investment [18]. In addition, vaccine markets have some particular constraints to entry because the number of firms engaged in vaccine production worldwide is small and production capacity is limited. Developing vaccines for developing countries is also complicated because the vaccines used for the immunization programmes in developing countries are relatively expensive compared with developed countries and have an increasing divergence [5]. Another constraints focus on the health condition of the developing world reflected the extent to which drugs have been developed to address the diseases that mostly affect poor people in developing countries. For example, only about 3% of approved drugs between 1975 and 1999 were relevant to infectious and parasitic diseases that were the most significant burdens of diseases in developing countries [13]. Over the same period, only about 1% of the drugs approved in Africa countries were also relevant to the numerous tropical diseases ravaging the continent.

Diseases such as TB, malaria, African trypanosomiasis, Chagas diseases and leishmaniasis are at this period bediviling the continent. Of all these, only malaria appears to be an area of infectious diseases which is attracting any substantial investment from pharmaceutical manufacturers [19].

5. ENHANCEMENT OF THE NEEDS FOR NEW HEALTH PRODUCT DEVELOPMENT

There is need to consider the characteristics of diagnostics, drugs, vaccines and scientific devices that could most effectively and efficiently address the critical continent health threats for these new products and poor people with financial resources [16]. The quality of health care in developing countries is low considering safety and is often poor with health systems that are poorly organize and cannot effectively manage logistics. Transport systems and storage of goods are weak and limited electricity supply for regular storage of goods at normal temperature for potency. It is important that diagnostics be affordable, specific and sensitive for easy treatment.

The ideal drugs need to be affordable and safe, effective, inexpensive and used for many years without being susceptible to resistance. It should require small doses over a limited period, easy to store, transports with stable temperature. People develop resistance for those drugs and some of them have serious side- effects [3]. The world need to encourage the development of safer and more effective AID drugs, HIV vaccines and mechanism by which women could protect themselves better from microbicides and the risks of HIV / AIDS.

Vaccines and delivery devices must meet the most important health needs in the developing world. They must be affordable, safe and effective, requiring few doses, easy to transport and store and would not require refrigeration. The ideal vaccines should be an inexpensive, combined with many antigens and only one dose would confer lifelong immunity against a number of diseases. There are gaps in the development of diagnostics, drugs, vaccines and medical devices that can serve the health needs in the developing world. In general, the public sectors have tried to reduce its risks by wanting for such products to be developed by private sectors due to its risks to produce products that are expensive to develop and for which an

adequate return on investment cannot be assured.

However, there are number of steps that could encourage a large share in the developing world such as push and pull mechanisms considering their impacts [19]. For example, encouraging products development by helping to reduce the costs of investment is one type of effort related to push mechanism. Push mechanisms include direct financing by the government on research activities, performing clinical trials and tax credit for research and development [7]. The push mechanism can reduce risk and encourage investment in product development but they provide no certainty that the desired products will be produced.

Another set of efforts could focus on pull mechanisms, which are intended to help assure a satisfactory return to investors in the event that a product is produced. These mechanisms could include increasing the uptake of existing vaccines, prices, transferable patents, co-payments, market assurance and tax credits for vaccine sales. It is now possible to conduct simple but life-saving diagnostic and treatment manuals, and tools to calculate pulse, respiratory rate, and proper drug dosages. The adaptation of inexpensive technology to health care and needs is a fast growing trend across the world especially in and for the developing countries like Nigeria.

6. SUMMARY AND CONCLUSION

Science and technology have the potentials to make major contributions to the development of diagnostics, vaccine, drugs and medical devices that address the highest burden of diseases both in the under-developed and developing countries. Progress in science and technology can help to engineer mosquitoes that could not carry diseases, discover new drugs and develop less expensive and more vaccines for communicable and non-communicable diseases. Science and technology could be appropriate to the needs of health conditions that cause the largest burden of diseases in developing countries of the world. The new health products through science and technology should be affordable, heat stable, not requiring refrigeration, easy to store and transport and require a short course of therapy.

The desired health products through science and technology could probably require a series of measures such as push and pull mechanism that are meant to lower the cost of research and development for the private sectors on new health products. These could include financial assistance of the government on clinical trials, offering tax credits for research and development using pull and push mechanisms focusing on increasing the uptake of existing vaccines prizes, transferable patents, and co-payments, market assurances and tax credits for vaccine sales.

Considerable hope for the new product development could be placed in public-private product development partnerships such as Medicine for Malaria Venture, International AIDS Vaccine Initiative and the Global Alliance for Tuberculosis Drug Development.

7. RECOMMENDATIONS

Towards understanding the potential of science and technology to develop more new health products and address high-burden diseases, the following recommendations were made:

1. There is need to consider the characteristics of diagnostics, drugs, vaccines and medical devices that could most effectively and efficiently address the health threats in the developing world.
2. Science and technology should focus on bio-technologies that can help improve health products that are affordable and appropriate to the circumstances in the developing countries addressing the most pressing health needs.
3. Science and technology should be appropriate to the health needs or conditions that cause the largest burden of diseases in developing countries of the world.
4. The constraints to applying science and technology to solve global health threats should be totally eradicated
5. The public and private institutions involved with science and technology should be aware of their responsibility to act, regulate, legislate, respecting human life and society and charge them in case of failure or omission.

6. International health programmes based on science and technology should provide opportunities for representatives to join with political and other intellectual and economic leaders of the world, and activists in the developing countries to continuing constructive dialogue on concrete health projects designed to enhance the quality of life of people.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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